Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

94.9
F 762
no. 2

L I B R A R Y

STATION PAPER NO. 12 OCTOBER 1959

NATURAL STOCKING OF A MILE-SQUARE CLEAR CUTTING IN SOUTHEAST ALASKA

GEORGE A. JAMES
AND
ROBERT A. GREGORY

ALASKA FOREST RESEARCH CENTER
U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
JUNEAU, ALASKA
A. E. HELMERS, ACTING FORESTER IN CHARGE

NATURAL STOCKING OF A MILE-SQUARE CLEAR CUTTING IN SOUTHEAST ALASKA

by George A. James and Robert A. Gregory

The development of sound timber management plans requires a complete knowledge of the silvical characteristics of the commercial timber species. Information on distance of seedfall is of primary importance in order that size and shape of timber sale cutting boundaries may be intelligently regulated to provide adequate natural stocking. This paper is a progress report of studies to determine seed dispersal distance and the development of reproduction in a large clearcut in Southeast Alaska.

A pulptimber-cutting operation on the Maybeso Experimental Forest 1/ provided a suitable area (fig. 1) for the study. One unit of the

Figure 1.--Clear cutting on the Maybeso Experimental Forest. The 700-acre clearcut is beyond the leave strip in the foreground.

1/ Located near Hollis, Kasaan Bay, Prince of Wales Island, Alaska.

cutting was made large in order to determine seed dissemination distance and to follow the development of natural reproduction. This 700-acre unit is approximately square, varies from steep to nearly level, and has a southwest exposure. The stand, typical old-growth, was roughly 76 percent western hemlock (Tsuga heterophylla (Raf.) Sarg.), 20 percent Sitka spruce (Picea sitchensis (Bong.) Carr.), and about 2 percent each of western redcedar (Thuja plicata Donn) and Alaska-cedar (Chamaecyparis nootkatensis (D. Don) Spach). Timber volumes averaged roughly 37 thousand board feet (Scribner) per acre.

Logging began in 1954 and was completed in 1957--most of the logging was during 1954 and 1955. Logging was by the high-lead method except for small areas that were tractor-logged. Residual trees of seed-bearing age in the clearcut were either felled or poisoned prior to seed ripening in 1956. Logging slash was left unburned.

A bumper cone crop of hemlock and spruce occurred in 1951. Seed production was nil or very light from 1952 to 1955, inclusive. The first reasonably good cone crop since logging was in 1956 when "medium" spruce and "light" hemlock crops were produced. A "medium" hemlock crop occurred in 1957.

Stocked quadrat surveys were made in 1957 and 1958 after logging was completed. 2/ For sampling purposes, the cutting was divided into four strata according to distance from seed source:

Stratum 1	0 - 10 chains
Stratum 2	10 - 20 chains
Stratum 3	20 - 30 chains
Stratum 4	+30 chains

The number of plots sampled in each stratum was determined by the ratio of the area of each 10-chain stratum to the total area of the cutting. Quadrat plot locations were selected randomly from a 2-chain by 5-chain grid superimposed on a cutting map of the area.

The 1-milacre quadrat method was adopted for the study instead of the more commonly used 4-milacre method. The smaller quadrat permitted an increase in sampling units, resulting in better distribution over the clearcut. Two hundred and ninety-four 1-milacre plots were examined in 1957; 306 1-milacre plots in 1958. The 1-milacre plots give results

---

2/ Approximately 350 acres were also surveyed in 1955 while logging was still in progress.

that are related to the 4-milacre method. This relationship was established in British Columbia coastal forest types [3/] and appears applicable to coastal Alaska.

Plots were rated as stocked if containing one or more seedlings at least one year old, in good condition, and free to grow; or two or more seedlings less than one year old, in good condition, and free to grow. In addition to rating each plot as stocked or nonstocked, information was also collected on seedling numbers, species, and age. Seedlings that germinated prior to cutting were called "advanced"; those germinating after logging were called "subsequent". Information on seedbed condition was obtained for each quadrat that contained no seedlings. Plots with a favorable seedbed on less than 20 percent of the surface were rated as to type of cover such as dense brush, dense slash, grass or sedge sod, or undisturbed moss-covered surface.

Forty-eight seed traps (2' x 3') were installed on the cutting during August 1956 to determine seed dispersal distance. They were placed in pairs 33 feet apart, and at 5-chain intervals for a distance of one mile in a southwesterly direction, beginning 5 chains from the upper timber edge. Another line of paired traps with the same spacing was run in a southeasterly direction beginning 5 chains from the west timber edge, intersecting the 1-mile-long line of traps. Four seed traps were placed in the uncut timber. Seed trap locations are shown in fig. 2.

RESULTS

Reproduction Occurrence

One-milacre stocking by seedlings of all ages was 58 percent in 1957 and 58.5 percent in 1958. This is approximately equivalent to 88 and 88.5 percent, respectively, on a 4-milacre basis. The 1955 survey showed a 1-milacre stocking of 38 percent and a 4-milacre stocking of 64 percent.[4/] Two medium cone crops since 1955 account for this increase in stocking percent.

3/ Allen, G. S., B. G. Griffith, and John W. Ker. A comparison of several regeneration survey methods in terms of cost and usefulness. Univ. of B. C. Res. Note No. 3. 6 pp., 1951.

4/ The 1955 survey included 1-milacre and 4-milacre quadrats.

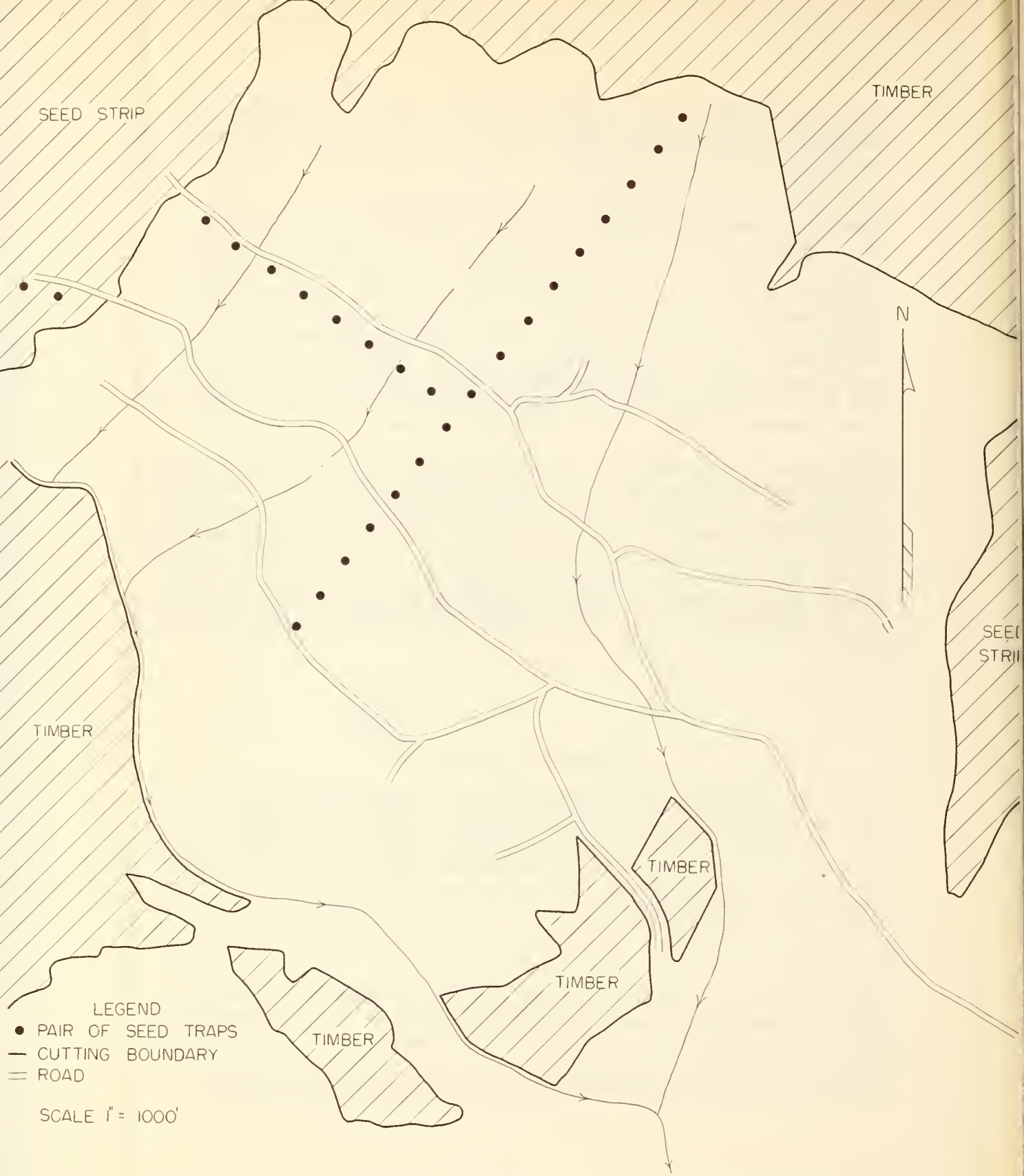

Figure 2.--Seed trap locations on the Maybeso Experimental Forest.

Despite severe ground disturbance caused by high-lead and tractor logging, many seedlings that had become established beneath the old-growth stands were observed to survive felling and yarding. Knowing seedling age, and having a map showing progress of logging, it was possible to determine whether seedlings germinated before or after the stand was felled. Many quadrats contained one or more advanced seedlings varying in height from a few inches to several feet. Stocking (milacre basis) of advanced reproduction on the Maybeso clear cutting has averaged 34 percent since logging; equivalent to 74 percent stocking on a 4-milacre basis. These seedlings are in a highly favorable position for becoming early components of the new stand.

Western hemlock is the predominant species in the regenerating stand. When considering total stocking, hemlock is almost twice as abundant as spruce; six times more abundant than western redcedar. When considering advanced seedlings only, the ratio is 3 times more hemlock than spruce. Only an occasional advanced redcedar was found on the quadrats. The overall species ratio has changed very little since 1955.

The 308 milacre quadrats contained 1,985 seedlings of all ages in 1958, equivalent to approximately 6,445 seedlings per acre. Of this total, 1,698 seedlings per acre germinated during 1958. Seedlings one or more years old numbered 4,747 per acre. Advanced seedlings, included in the total, averaged 2,279 per acre.

Seedlings were generally well distributed over the entire cutting. The relative uniformity of overall stocking is shown by a comparison between distance strata (table 1). Average number of seedlings per acre by strata is shown in table 2.

Table 1.--Milacre stocking percent by distance from seed source, 1958

Category	Distance from seed source (chains)				Mean
	0-10	10-20	20-30	+30	
	Percent of quadrats stocked				
Advanced and subsequent	65	52	47	70	58.5
Advanced	28	25	28	41	30.5
Subsequent	58	44	42	56	50.0

An anomaly exists in stocking percent and in numbers of advanced and subsequent seedlings found in the strata located in the center of the cutting. Considerably better stocking and a greater number of seedlings were found in this stratum than would be expected due to its greater distance from seed source. Though some condition of site, topography,

Table 2.--Average number of seedlings per acre by distance from seed source, 1958

Category	Distance from seed source (chains)			
	0-10	10-20	20-30	+30
	Number			
All advanced	2,460	1,918	933	5,740
All subsequent	6,218	2,784	2,117	4,296
1958 seedlings only	2,660	1,430	550	780

weather, or ground cover must exist to explain the anomaly, no observable condition was found. A partial explanation for the large number of seedlings found in the +30 stratum is the fact that one of the mil-acre plots contained 134 seedlings. This number was exceeded only in the 0-10 chain stratum where one plot contained 139 seedlings. The greatest number of seedlings found on any plot in the other two strata was 44 and 45.

The two most prevalent types of undesirable seedbeds were dense slash and dense brush. Both of these conditions were encountered frequently, but seldom did they predominate on 80 percent or more of the plot surface. Results of all surveys show that approximately 15 percent of the area was occupied by unfavorable seedbeds.

Dense slash precluded seedling establishment in a few areas. Slash appears to be less of a threat in high-lead yarded areas than in tractor yarded areas where it is often piled along the edges of skid roads. Conifer seedlings were absent in dense patches of salmonberry and currant. Brush is a minor threat at present, but it may become a major threat in some areas where conifer regeneration is delayed. 5/ This is particularly true on moist, well-drained sites in the valley bottoms where brush is often present prior to logging and develops rapidly following logging. A few areas of active soil sloughing, such as along steep drainages, were poorly stocked.

Seed Dispersal Distance

Seedfall in 1956 occurred late in the season. Practically no seed was released during September, October, or November. Heavy seedfall

5/ Andersen, H. E. The problem of brush control on cutover areas in Southeast Alaska. Alaska For. Res. Center Tech. Note No. 33, 2 pp., 1956.

occurred in December 6/ during a period of heavy snow and strong wind. Few seeds were caught in the traps, however, as the trap tops were covered by snow and the seeds were carried away on the snow surface. Seed was most abundant near the edges of the cutting during this period, but wind-blown seed was observed on the snow in the center of the cutting. Much of the subsequent stocking shown in tables 1 and 2 is due, most likely, to seed that had blown over the snow.

The 1957 cone crop was rated "medium" for western hemlock. Approximately 3.5 million seeds per acre fell in the uncut timber, 36 percent of which were sound. The quantity of seed dispersed into the clearcut dropped rapidly from the edge of the uncut timber. The relationship between trap catch and distance was found to be highly significant (fig. 3). An average of 156,000 hemlock seeds per acre were dispersed at a distance of 5 chains; an average of about 91,000 seeds per acre at 40 chains. Thirty-four percent of this seed was sound.

DISCUSSION

The forest manager might look with satisfaction at the present stocking condition of the large clearcut. The 1958 reproduction survey showed desired stocking 7/ over the entire cutting, acceptable species composition, and a fairly large number of seedlings per acre. He might even ask himself if future cuttings might not be made as large as this experimental cutting of 700 acres.

Results of the reproduction surveys and seed dispersal study suggest, however, that cutting size be kept smaller than 700 acres. Probably the most important reason is that conifer seed is generally dispersed only a short distance from the timber edge (fig. 3). Traps in the timber caught approximately 3.5 million seeds per acre in 1957 and 1958. Traps at five chains distance caught 4.5 percent of this amount, and at 40 chains only 2.6 percent. These findings agree with a study in 1953 8/ which showed that a 12-acre opening received only 10 percent of the amount of seed that fell within the adjacent uncut timber.

6/ Late seed dissemination may occur more frequently than is generally suspected. Again in 1958, practically no seedfall occurred during September, October, or November. The first, but light, seedfall occurred in early December.

7/ Stocking standards for the Alaska Region require a minimum of 70 percent stocking by 4-milacre plots for "desired" stocking, and 40 to 69 percent for "satisfactory" stocking.

8/ Godman, R. M. Seed dispersal in Southeast Alaska. Alaska For. Res. Center Tech. Note No. 16, 2 pp., 1953.

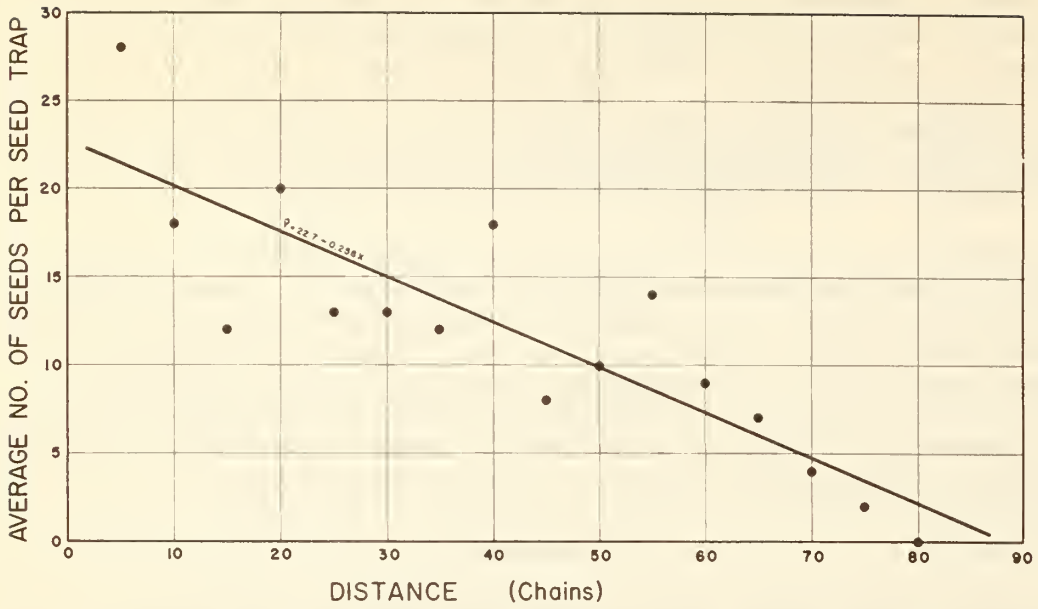

Figure 3.--Dispersal distance, 1957 seed.

Stocking is dynamic and may increase or decrease from year to year. Annual changes in seedling numbers and stocking percent of important magnitude have occurred in the large clearcut since 1955. Advanced seedlings, a very important component of present stocking, have decreased in numbers. This advanced stocking dates back to the bumper 1951 seed crop. Stocking percent by advanced seedlings only was 37 percent in 1955, and 31 percent in 1958; a decrease of 6 percent in 3 years. Mortality has also reduced the number of subsequent seedlings. Total stocking remained uniform during 1957 and 1958, 58 and 58.5 percent, respectively (milacre basis). But this stocking did not consist entirely of established seedlings. Ten percent of the total stocking in 1958 was made up of plots containing 2 or more 1958 germinants. This 10 percent increment was nullified by the combined mortality of subsequent and advanced seedlings between the 1957 and 1958 surveys. Most of this mortality can probably be attributed to the very dry spring and early summer in 1958. Numerous seedlings marked for detailed observations died of dessication. Many additional seedlings appeared chlorotic and of poor vigor.

Continued mortality, coupled with several years of nil or light seed crops, could result in less than full stocking on the experimental cutting. The threat of a catastrophic reduction in seedling numbers by some agency such as wildfire, small mammals, or insects, makes it desirable that clearcuts be of a size that may stock naturally from a local seed source; at least until full stocking is assured.

Reproduction surveys made in 10 additional cutover areas in Southeast Alaska provide some information regarding the relationship between size of cutting and stocking percent. The Kasaan District of the South Tongass National Forest 9/ found an average of 63 percent stocking (4-milacre) by established seedlings on areas cut over from 1 to 4 years previous. Reproduction less than one season old brought the average up to a desired stocking level of 73 percent. These areas averaged 80 acres in size and ranged from 32 to 178 acres.

The optimum size of clearcuts in Southeast Alaska will not be known until more results are available on the ultimate role of advanced reproduction, frequency of seed years, season of seed dissemination, and the threat of fire in cutover areas. Until then, the present "rule of thumb" that no part of the cutting be more than 20 chains from an effective seed source should be continued.

9/ From figures supplied by the Kasaan District Ranger, South Tongass National Forest, U. S. Forest Service, Ketchikan, Alaska.

GPO 993183

GPO 993765